

Poster prepared for:



Do not cite or distribute without  
author's permission

# Multi-scale impact assessments

detect impact, infer its mechanism and consequences and provide tools for management

David Lusseau<sup>1,2</sup>, James E.S. Higham<sup>3</sup>, Steve M. Dawson<sup>4</sup> & Liz Slooten<sup>1</sup>

University of Otago, Departments of <sup>1</sup>Zoology, <sup>3</sup>Tourism, and <sup>4</sup>Marine Sciences, Dunedin, New Zealand

University of Aberdeen, <sup>2</sup>Lighthouse Field Station, Cromarty, UK

<sup>2</sup>E-mail: [d.lusseau@abdn.ac.uk](mailto:d.lusseau@abdn.ac.uk), Website: <http://www.lusseau.org>

## Introduction

Interactions with boats impact the ecology and biology of dolphins. However, the exact mechanisms of these impacts as well as their biological cost remain uncertain. We decided to assess this issue using a multi-scale impact assessment, focussing both on responses at the individual- and group-level and collecting information that would enable us to infer biological cost. We were also able to compare these effects in two neighbouring populations exposed to different levels of boat interactions: over the two years of the study, 3500 tours were undertaken in Doubtful Sound, while more than 17000 trips were offered in Milford Sound. We present here the framework we used as well as the management guidelines we proposed to mitigate the impact of tourism activities on bottlenose dolphins in Fiordland, New Zealand.

Biological cost is not always this easy to detect:

Calf hit by a tour boat in Milford Sound. He subsequently died.



## Immediate reactions

More nonvocal communication events (Lusseau submitted) are performed when powerboats are present and boats go fast by the animals



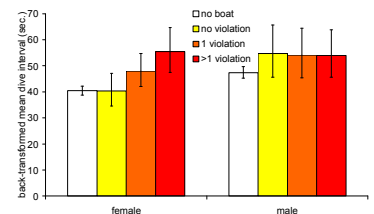
**Result: masking is a problem**

## The energetic cost of various types of interactions

(Lusseau 2003b)

The behaviour of vessels (violations of the MMPA regulations) explains the variation in dive intervals better than the type of vessels.

Males adopt a vertical avoidance strategy in any interaction, while females vertically avoid boats when these become intrusive.



**Result: the behaviour of the boat is more of a problem than the type of vessel involved and avoidance strategies are more costly for females**

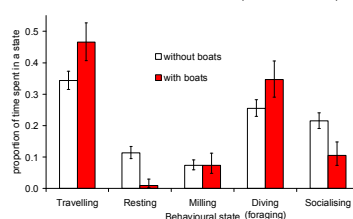
## The biological cost of interactions at the population level

(Lusseau 2003a)

Dolphins are more likely to start travelling while interacting with boats.

Boat interactions are more likely to disrupt resting and socialising bouts.

Their behavioural budget (i.e. their energetic budget) while interacting is significantly more expensive than when they are without boats.



**Result: If dolphins spend more than 35% of their time with boats their overall behavioural budget is significantly altered.**

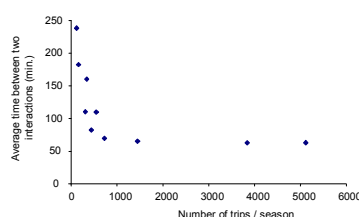
## When is it too much? Comparing with another fjord

(Lusseau 2004a,b)

Same effects on behavioural states in both fjords

Milford Sound: the likelihood to encounter dolphins in the fjord is related to boat traffic

If less than 68 minutes between two boat interactions, dolphins actively avoid interactions by avoiding the area.



**Result: Dolphins need at least 68 minutes between two boat interactions**

## Conclusions

1. Acoustic masking of vocalisations plays a large role in the impact of boat interactions. However, all boats can elicit an avoidance response from dolphins if they behave erratically (including kayaks).
2. Interactions are perceived as quasi-predation by dolphins.
3. The cost of boat interactions can be matched by dolphins if there is at least 70 minutes between two interactions.
4. Interactions need to be avoided when dolphins are resting and socialising. There are spatial preferences for these states.
5. Dolphins live in multi-male, multi-female groups therefore differential management for females is not possible.
6. The behaviour of vessels can be policed for operators that are permitted (under the MMPA) to interact with dolphins.

## Management recommendation: multi-level sanctuary

(Lusseau & Higham 2004)

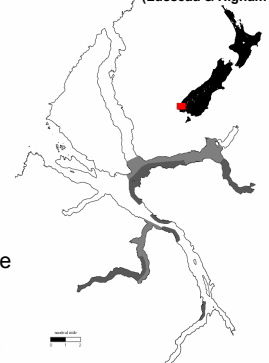
Less than 15% of the fjord is restricted in access

Likelihood that dolphins will encounter boats when resting or socialising is reduced by 75%

Increase intrinsic economic value of the area

Permitted operators and researchers have privilege access to areas where they are likely to encounter dolphins

Easy to police, even remotely (webcams)



Sanctuary proposal in Doubtful Sound: no boat zones are dark grey, zones for permitted operators are light grey.

**References** (reprints are available at <http://www.lusseau.org>)

Lusseau D. 2003a *Conservation Biology* 17(6): 1785-1793; Lusseau D. 2003b *Marine Ecology Progress Series* 257: 267-274; Lusseau D. 2004a *Ecology and Society* 9(1): 2; Lusseau D. & Higham J.E.S. 2004 *Tourism Management* 25(6): 657-667; Lusseau D. submitted *Ethology*; Lusseau D. 2004b IWC Cape Town [www/iwc.org](http://www.iwc.org)

## Acknowledgements

This study was funded by the New Zealand Department of Conservation. Additional support provided by Real Journeys Ltd., New Zealand Whale and Dolphin Trust, and University of Otago.